Face Recognition
&
Facial Expression Detection

By

Bikash Kumar Behera

Department of Electronics & Communication Engineering
National Institute of Technology Rourkela
Rourkela-769 008, Odisha, India
May 2015

Face Recognition
&
Facial expression Detection

Dissertation submitted in
May 2015
To the Department of Electronics & Communication Engineering
Of
National Institute of Technology Rourkela
In partial fulfilment of the requirements
For the degree of
Bachelor in technology

By

Bikash Kumar Behera
(*Roll NO. – 111EC0166*)

Under the Guidance of

Dr.(Prof.) Manish Okade

Department of Electronics & Communication Engineering
National Institute of Technology Rourkela
Rourkela – 769 008, Odisha, India

Declaration

I, Bikash Kumar Behera, pronounce that this titled, "Face Recognition & Facial Expression Detection" and the work exhibited in it are my own. I affirm that :

- This work was done entirely & predominantly while in candidature for a Bachelor degree at this Institute.

- Where any piece of this postulation has beforehand been submitted for a degree or whatever other capability at this Institute or any others, this has been obviously expressed.

- Where I've counseled the distributed work of others, this is dependably plainly ascribed.

- Where I've cited from the work of others, the source is constantly given. Except for such citations, this proposal is completely my own work.

- I've recognized every fundamental wellspring of assistance.

- Where the theory is in view of work done without anyone else together with others. I've made clear what precisely was finished by others and what I've contributed independent from

_____

(Signature)

_____

(Date)

NATIONAL INSTITUTE OF TECHNOLOGY ROURKELA

CERTIFICATE

This is to guarantee that the postulation entitled, "Face Recognition & Facial Expression Detection" presented by Bikash Kumar Behera bearing roll no. 111EC0166, is a record of his work did by him under my watch and direction in fractional satisfaction of the prerequisites for recompense of Bachelor in Technology Degree in Electronics & Communication Engineering.

Prof. Manish Okade

Acknowledgement

I am appreciative to different close-by and overall partners who've helped towards forming this postulation. Toward the starting, I may need to express my actual on account of Prof. Manish Okade for his proposals all through my postulation work. As my administrator, he has constantly influenced me to stay focused on achieving my target. His observations and comments helped me to assemble the general course of the examination and to push ahead with exploration in significance. He has helped me fundamentally and been a wellspring of data.

I am thankful to my fellow classmates: Subhrajyoti Senapati, Saurabh Kumar Sahu, Prabir Kumar Choudhury, Lagnajeet Sahoo, for their intellectual discussions and advices.

I am deeply and forever be indebted to my parents for their love, support, guidance and encouragement throughout my life without it I would have not become what I am now.

Bikash Kumar Behera

Abstract

The "Face Recognition System" is a PC based application for distinguishing an individual from an advanced image(.pgm/ .jpeg … .).

It's finished by contrasting the chose facial highlights from the picture & a facial database.

It's in light of the geometric highlights of a face, which is most likely the most instinctive way to deal with face acknowledgment. One of the initially mechanized face acknowledgment frameworks was marker focuses (position of eyes, ears, nose, button… .) were utilized to assemble a highlight vector (separation between the focuses, edge between them, …).

The acknowledgment was performed by SVD (Singular Value Decomposition) calculation, HMM (Hidden Markov Model) calculation. Such a technique is strong against changes in brightening by its inclination.

Programmed Facial Expression Recognition and Investigation, specifically FACS Action Unit (AU) identification and discrete feeling location, has been a dynamic point in PC science for more than two decades. Institutionalization and likeness has come somehow; for occasion, there exist a number of usually utilized outward appearance databases. Be that as it may, need of a typical assessment convention and absence of sufficient subtle elements to repeat the reported individual results make it difficult to contrast frameworks with one another. This thus obstructs the advancement of the field. A periodical test in Facial Expression Acknowledgment and Analysis would permit this correlation in a reasonable way. It would elucidate how far the field has come, and would permit us to recognize new objectives, difficulties and targets. In this paper we introduce the first challenge in programmed acknowledgment of outward appearances to be held amid the IEEE gathering on Face and Gesture Recognition 2011, in Santa Barbara, California. Two sub-difficulties are defined: one on AU recognition also, another on discrete feeling location. It plots the assessment convention, the information utilized, and the aftereffects of a pattern strategy for the two subs.

Keywords: face Recognition, PCA, Euclidean Distance, FERET database, Edge Detection, Color Space, Face Detection, Extracting FCPs

Contents

CHAPTER 1

Introduction:

A face acknowledgment framework is one of the well-known Computer Application for programmed verification or identification of any individual either from a given picture or from any feature source. Face acknowledgment is for the most part utilized for the security reason and one can pose as a viable rival this with alternate biometrics like fingerprint, iris acknowledgment framework. The principle points of interest of a face acknowledgment framework over alternate biometrics application is that it a bit much need to request that the individual come before cam or in any sensor like in other it obliged the individual ought to take his body before the sensor and stay there for couple of second. For the face acknowledgment if an individual is basically strolling from any observation cam it can catch data of the individual without his/her thinking about that and can recognize or confirm the individual. In a face acknowledgment issue we are essentially giving an info picture and the facial database of the individual known people and it distinguish or confirm the given picture. There are essentially two methodologies for the face acknowledgment: geometrics (highlight based) and photometric (perspective based). In the geometrics we have to choose just some unmistakable highlights like nose, eyes, mouth and measure the geometric relationship among these facial framework.

Face Recognition Technique:

Traditional:

There are a few calculations which separate the facial highlights or historic points from a picture for instance the position of nose, eyes, jaw and cheekbones. In the wake of removing these highlights, then it is utilized for the coordinating the comparable highlights in the picture database.

3-dimensional acknowledgment:

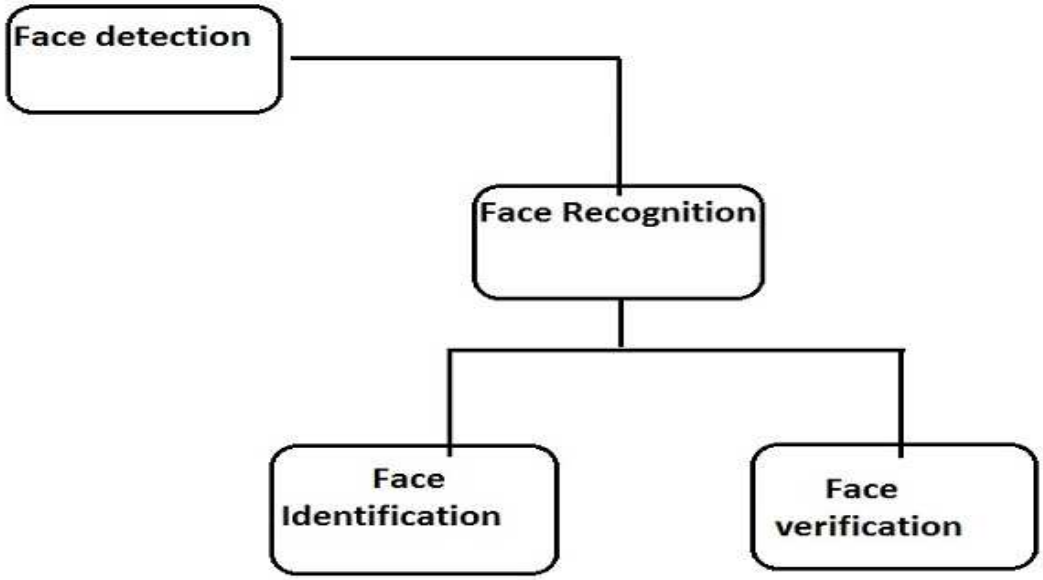
Now days the 3-dimensional acknowledgment method is exceptionally mainstream and basically utilized for the face acknowledgment. Other methods are not a great deal more precise in the different lighting and in non-frontal

perspective, yet in 3-D acknowledgment there is no effect of changes in lighting. In this method, it obliged a 3-D sensor for getting the data about the face surface. At that point this data is utilized for distinguishing or verification of any individuals.

Skin composition investigation:

The visual subtle elements of the skin are utilized as a part of this strategy which are caught in measures computerized picture or checked picture. This skin composition investigation enhances the execution on the perceiving the face.

Its uses:



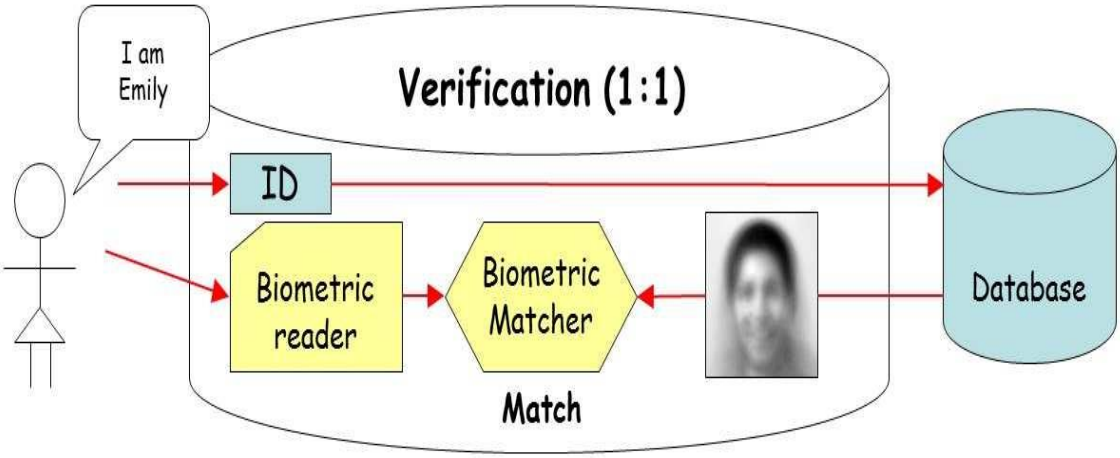
Identification:

In the identification a face acknowledgment framework takes an information picture and contrasted it and the various pictures in the database and in result it gives the rank savvy rundown of the coordinated picture. In the identification one picture is contrasted and all the pictures in the database and the picture which will be like the information picture.

Verification:

In the verification a face acknowledgment framework takes an info picture and case of character and contrasted it and who they say they are and it give the answer yes or no. In verification balanced correlation is finished by the framework implies the information picture is contrasted and right now

determine an picture in the database and on the off chance that it will coordinate it will give a yes answer generally it will give no answer and verification can be clarified.



Face Recognition Steps:

1. Picture obtaining:

   This is the very first venture for the face acknowledgment in this needed for obtaining of any picture either by cam or by whatever other source.

2. Picture Pre-processing:

   Some pre-processing is obliged to perform before utilizing the procured picture for the acknowledgment.

3. Face identification:

   After doing the pre-processing now it needed to identify the face of the given picture. Since for performing the face acknowledgment we essentially need a face of any individual. So the face discovery is done before performing the face acknowledgment.

4. Highlight extraction:

The following venture after face identification is separating the essential highlights of the face, which can be utilized for contrasting and the picture database of people.

5. Proclaiming a match:

After performing the above steps it needed to recognize or check the given picture from the database. In this we can order any given picture in face or non-confront or in whatever other gatherings as per the prerequisite.

Applications:

1. Security:

If anybody needs to give the entrance control to just specific individual then he/she can apply the face acknowledgment there. Case in point, needs to offer access to air terminal, structures, ATM machine.

2. Observation:

Now day, bunches of reconnaissance cams are utilized for observing any known criminal if anybody goes through that cam he/she can without much of a stretch recognition.

3. General character verification:

Face acknowledgment can be utilized for confirming the personality of any individual. For instance voter ID, driving permit, worker ID and so on.

4. Feature indexing:

The face acknowledgment can likewise use in the range of feature indexing for example, bailing faces in feature.

5. Criminal equity frameworks:

The face acknowledgment can be utilized as a part of the field of Criminal equity System, for example, mug-shot/booking frameworks, post-occasion investigation, crime scene investigation and so on.

Motivation:

The face acknowledgment can be connected in a few territories, despite the fact that face acknowledgment is not the most efficient among different biometrics. The fundamental focal point of the face acknowledgment over the other biometric application is that its not so much need to request that the individual come before cam or in any sensor like in others, it obliged the individual ought to take his body before the sensor and stay there for a couple of second. Face acknowledgment can be utilized as a part of such a large number of regions like security, criminal equity frameworks and feature indexing and so on. There is no framework which can give better results in Variations in lighting conditions, stance, and representation. It is difficult and testing errand to make a framework which will perform well in different posture and varieties in lighting. The most imperative thing needed for the face acknowledgment is power.

Challenges:

1. Light variety

2. Change in the declaration

3. Change in Camera point

4. Head posture

5. Development of facial hair because of age or copied hair joined to trick the framework.

Advantages:

1. It is useful for finding any missing kids.

2. It can recognize any culprits, terrorists, and so on.

3. It can keep from the voter misrepresentation.

4. For the identification of any person there is no compelling reason to reach with a person to check their personality. Dissimilar to in other framework (fingerprints, Voiceprint, signature).

5. Different biometrics, for example, fingerprints, iris sweeps, and discourse acknowledgment are definitely not ready to perform mass identification.

Disadvantages:

1. Face acknowledgment frameworks are not ready to perform well in the variety of light.

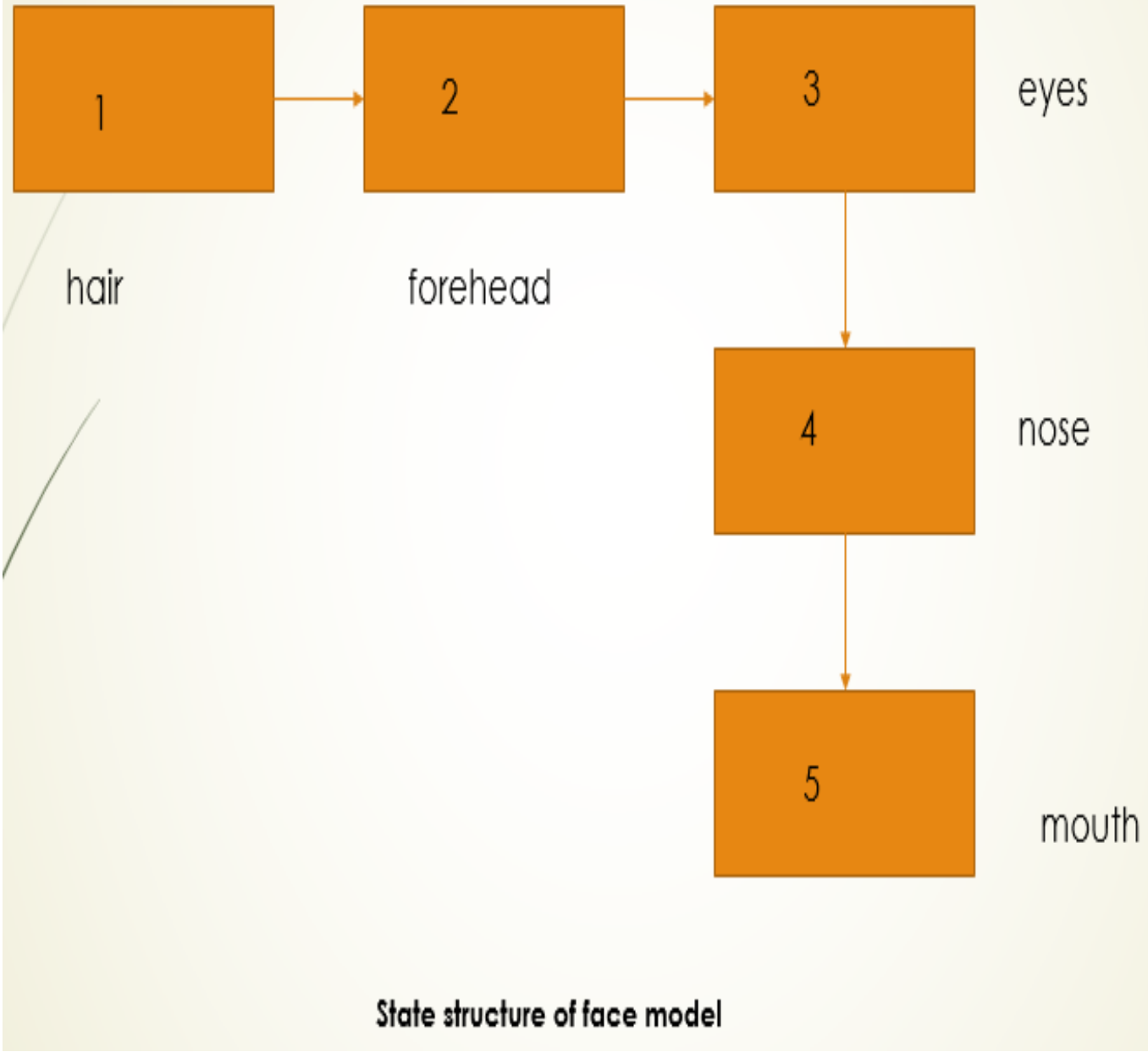
2. Face acknowledgment frameworks are not generally exact.

3. In poor lighting, shades, long hair, low determination picture face acknowledgment does not function admirably.

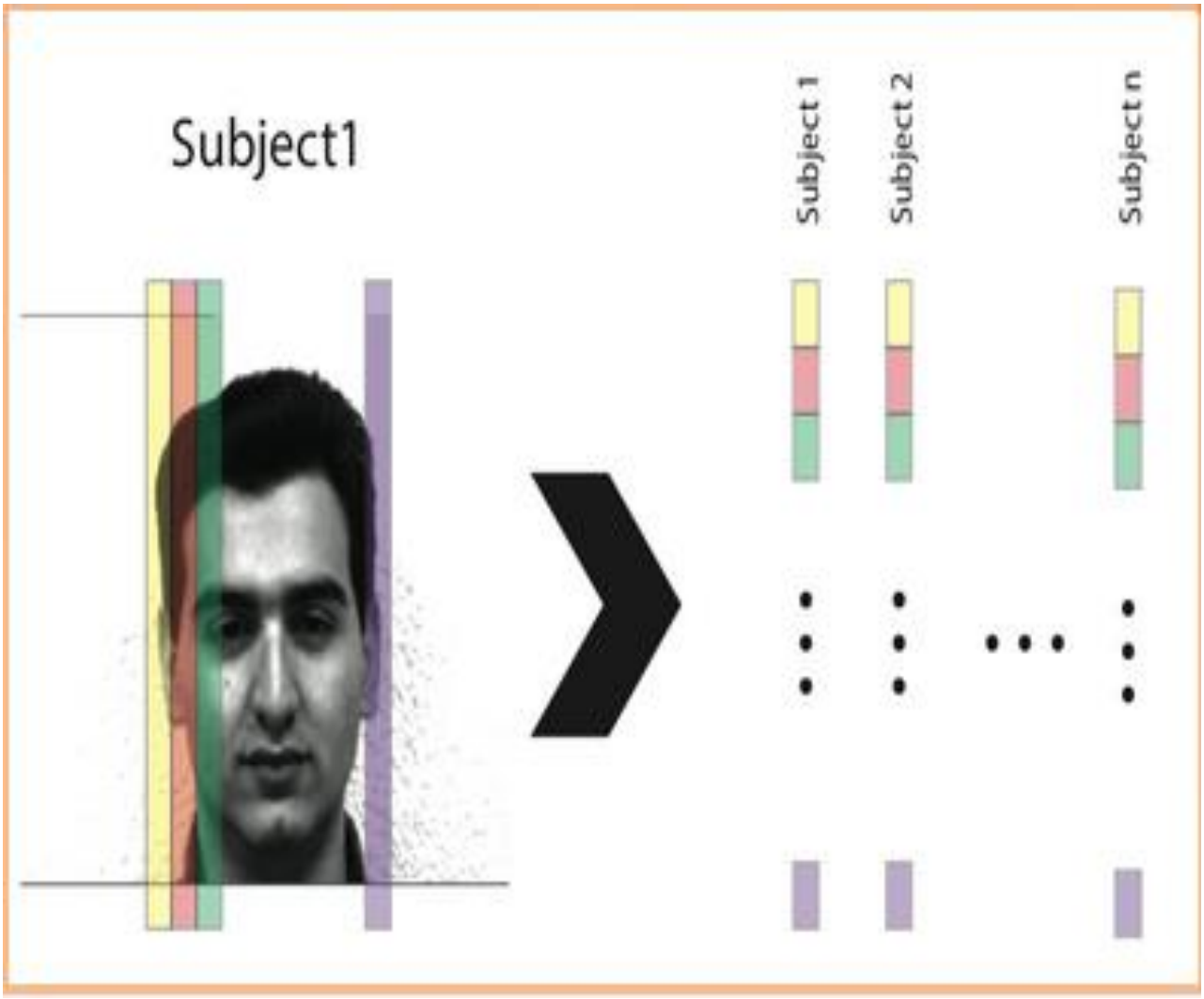
Feature Extraction Methods:

There are such a large number of existing calculations are accessible to concentrate highlights from any facial pictures, for example, Principal Component Analysis (PCA), Fisher Linear Separate Analysis (FLDA), direct discriminant examination (LDA), Image central segment examination (IPCA) and different others. Here we have utilized central segments examination.

Face image HMM :



State structure of face model

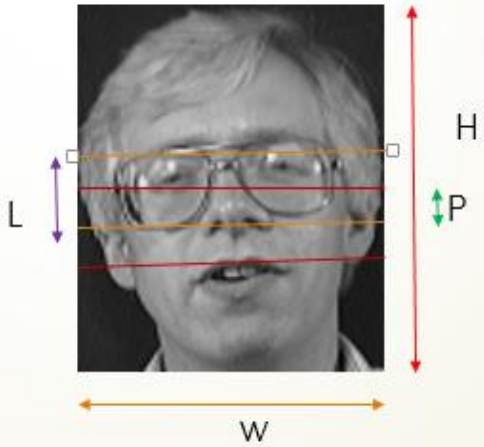


[Image is being unfolded into a vector corresponding features]

Feature Extraction :

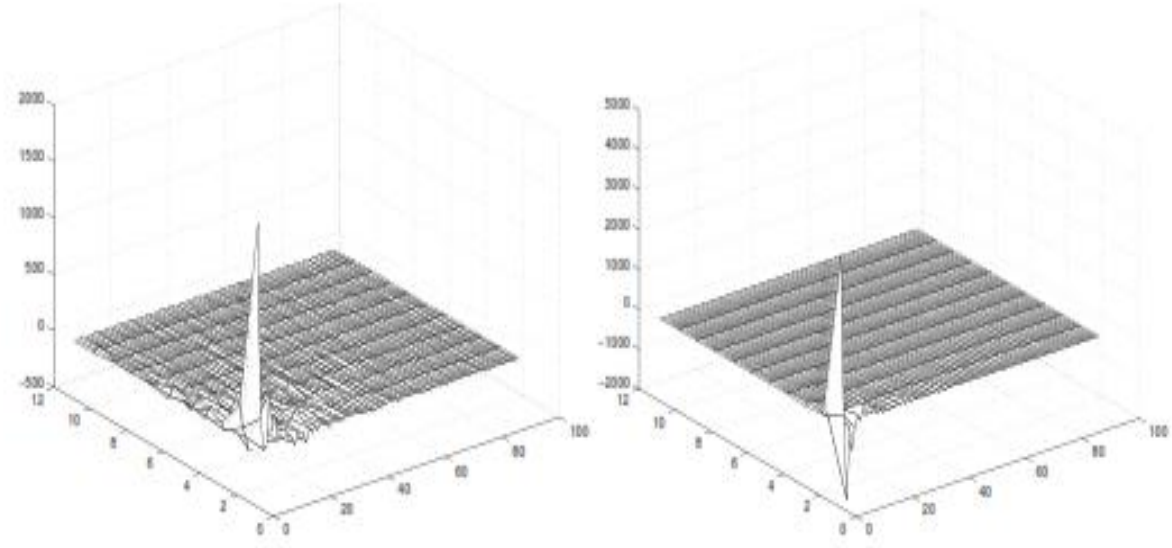
T = (H - L)/(L - P) +1

T – no. of observations vectors = no. of blocks extracted from each face image
W – face image width
H – height of face image
L – overlapping blocks of height
P – amount of overlap between consecutive blocks

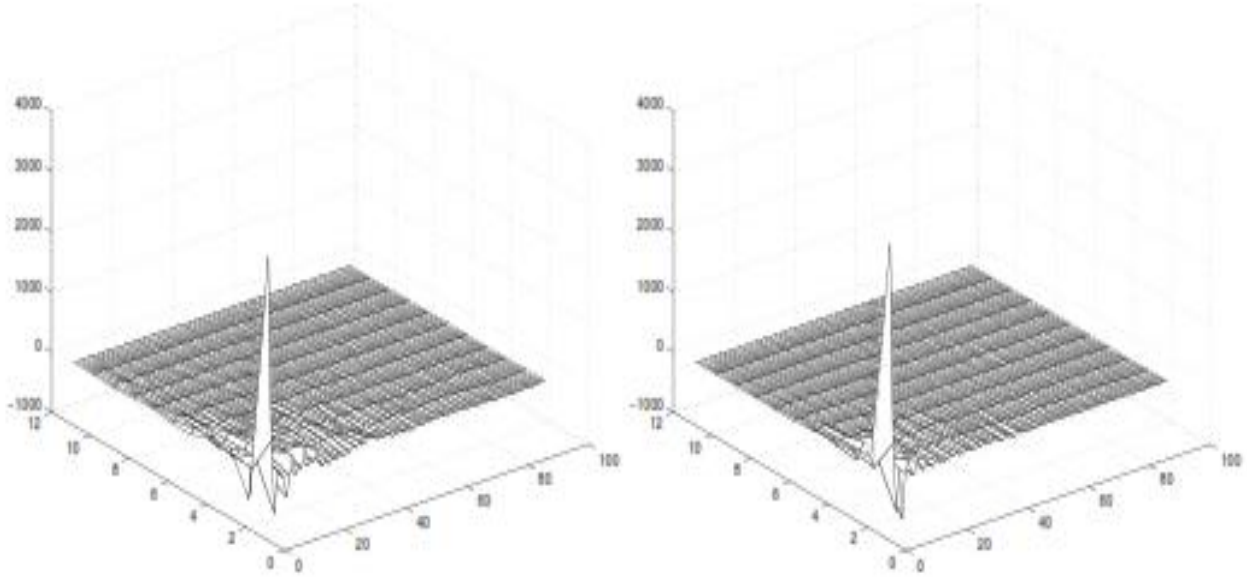


Face Image Parameterization & Blocks Extraction

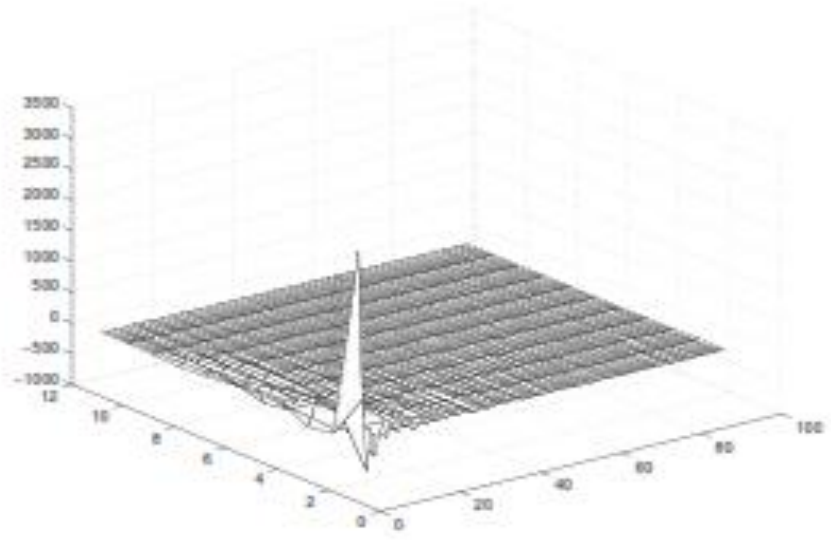
Training Face Modules:



[Hair(left) and forehead(right)]

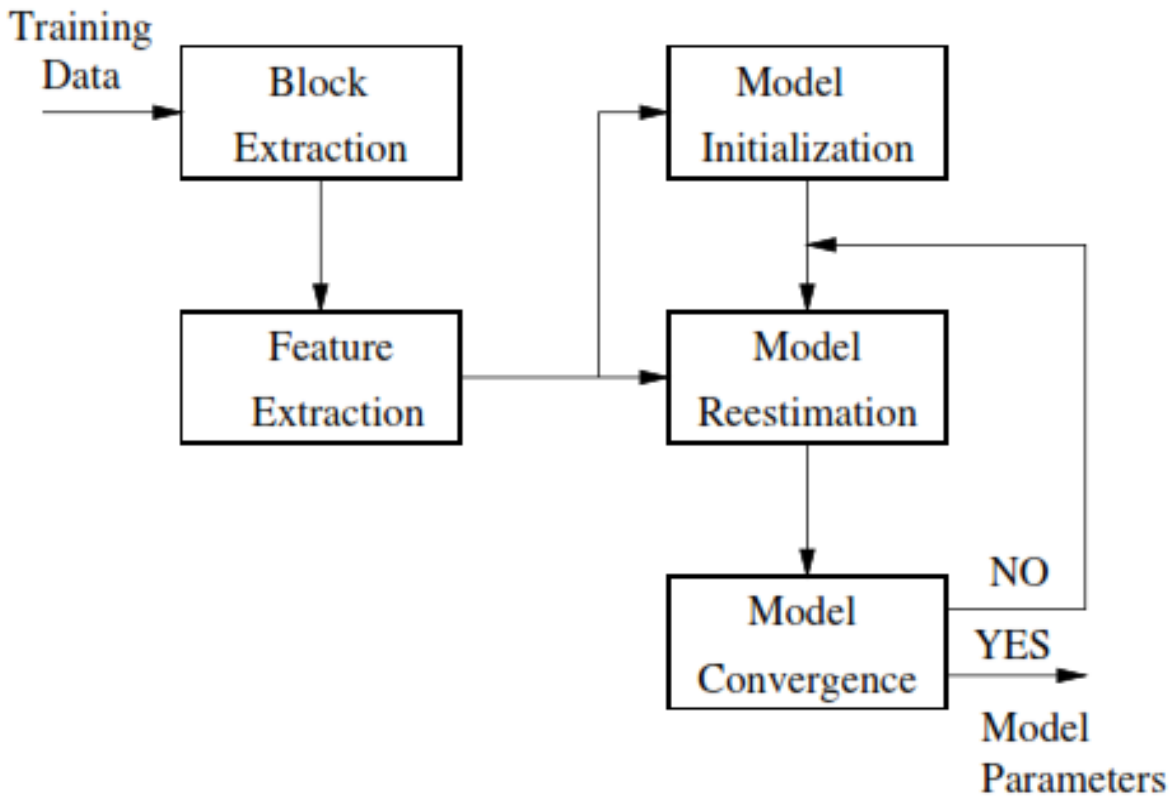


[Eye(left) and nose(right)]

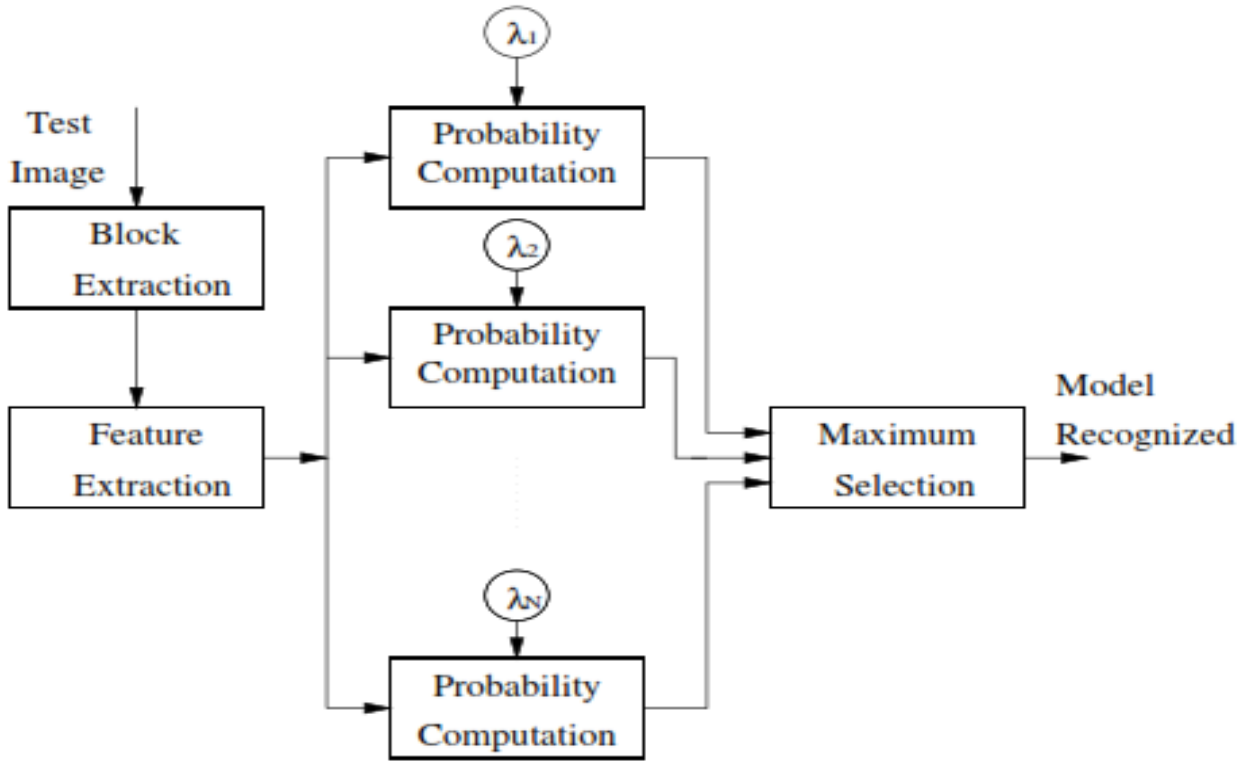


[Mouth]

Recognition Result:

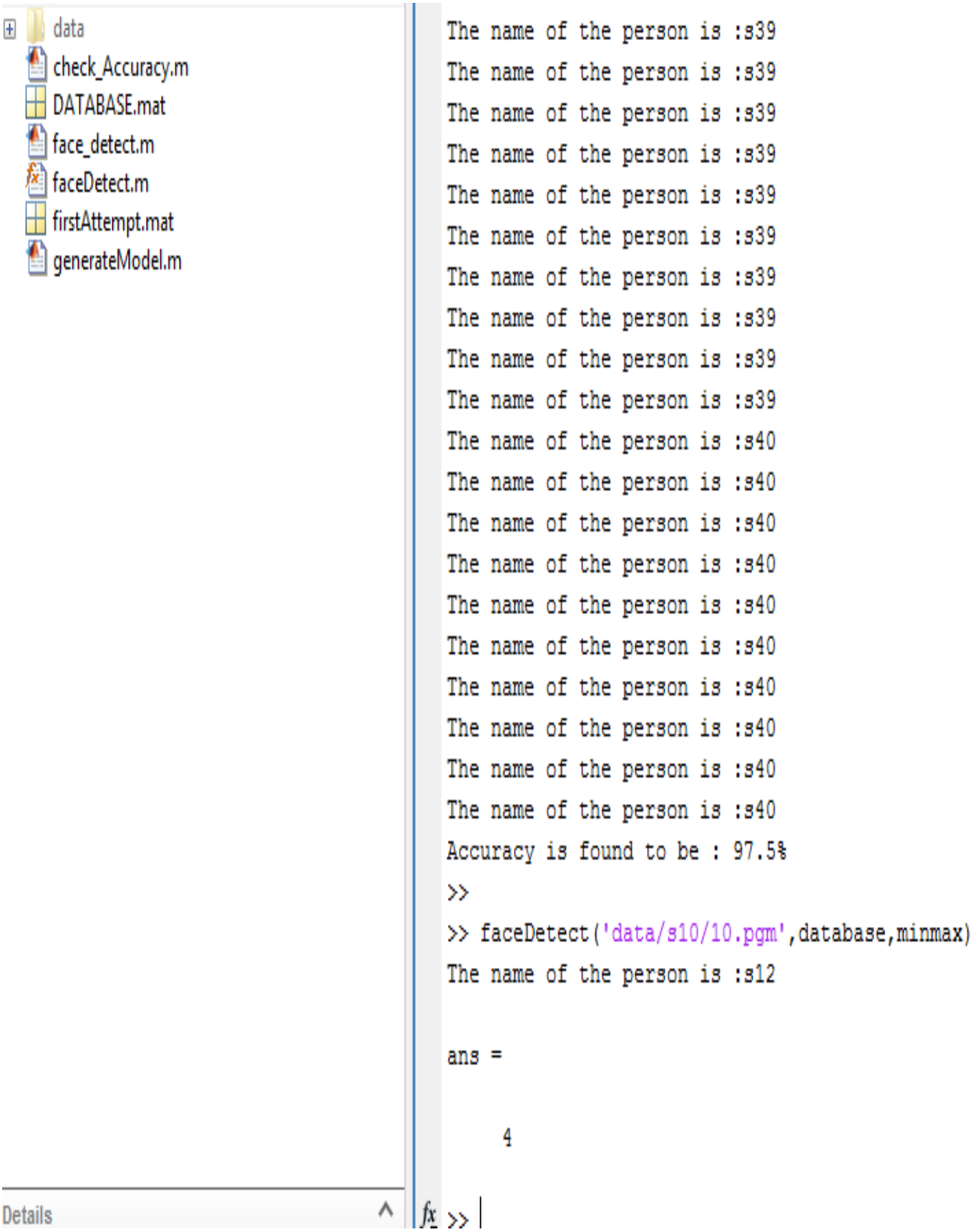


[HMM Training Scheme]



[HMM Recognition Scheme]

Result:


data
check_Accuracy.m
DATABASE.mat
face_detect.m
faceDetect.m
firstAttempt.mat
generateModel.m
Details
The name of the person is :s39
The name of the person is :s39
The name of the person is :s39
The name of the person is :s39
The name of the person is :s39
The name of the person is :s39
The name of the person is :s39
The name of the person is :s39
The name of the person is :s39
The name of the person is :s39
The name of the person is :s40
The name of the person is :s40
The name of the person is :s40
The name of the person is :s40
The name of the person is :s40
The name of the person is :s40
The name of the person is :s40
The name of the person is :s40
The name of the person is :s40
The name of the person is :s40
Accuracy is found to be : 97.5%
>>
>> faceDetect('data/s10/10.pgm',database,minmax)
The name of the person is :s12
ans =
4
>>

CHAPETR 2

Introduction:

Human outward appearance acknowledgment(FER – Facial Expression Recognition) has pulled in much consideration as of late on account of its significance in acknowledging exceptionally shrewd human-machine interfaces. Human outward appearance contains amazingly plenteous data of human‟s conduct and can further reflect human‟s comparing mental state. As human face assumes a vital part in interpersonal correspondence, outward appearance investigation is dynamic in the fields of full of feeling registering and smart associate.

Feature Extraction using Template Matching:

Highlight extraction is the procedure of removing essential ascribe which are utilized to characterize the pictures into diverse classes. Layout coordinating is being done by making utilization of convolution and relationship coefficients for the most astounding and immaculate coordinating. The fancied eyes, eyebrows and mouth layout are being selected from the picture and the extracted results are demonstrated as limited rectangles.
The calculation functions as takes after

1) Input the layout and the target picture.

2) Convert the pictures into dim scale pictures.

3) Find the 2-d convolution of the target and layout picture.

4) Find the mean and difference of the layout picture.

5) Form the inquiry picture from the pursuit locale of the

Layout size.

6) Calculate the relationship score „C‟.

7) Find the pixel esteem from the inquiry area having.

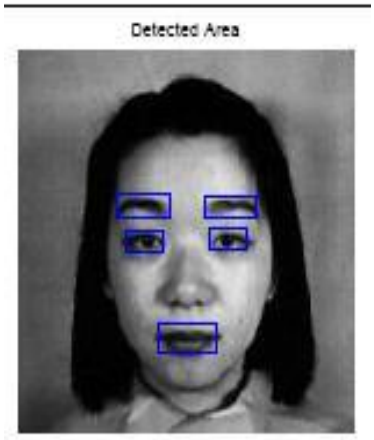
8) The most elevated estimation of the relationship score „C‟.

9) Draw the jumping rectangles by utilizing the record of the

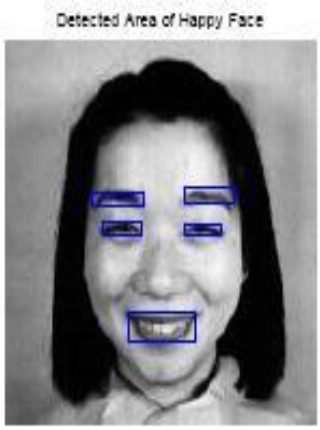
Coordinated relationship.

Extracting the facial characteristic point:

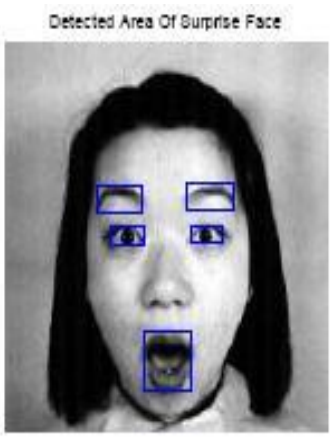
The bouncing rectangles shape around the coordinated layout is utilized to conclude the estimation of upper left corner pixel from the rectangles. By utilizing width & tallness of the layout estimate as determined in the database table. Those pixel qualities are utilized to assess the facial activity parameters portrayed as opening of eyes (oe), width of eyes(we), stature of eyebrows(he), opening of mouth(om), and width of mouth(om).



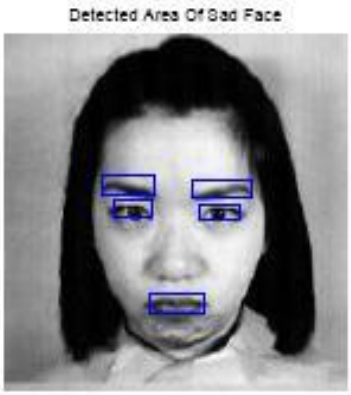
Neutral Face



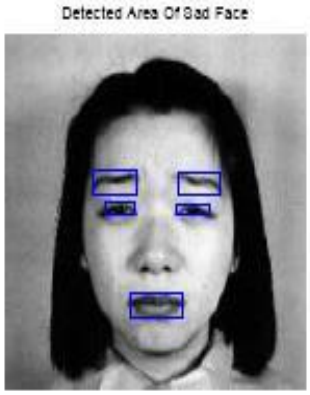
Happy Face



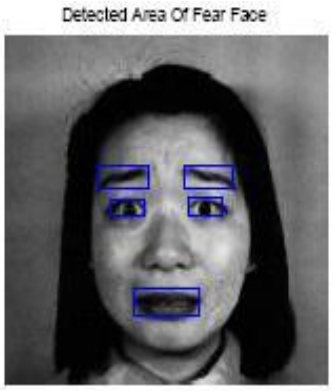
Surprise Face



Angry Face



Sad face



Fear Face

[template matching is applied in different facial expressions]

Region	FCP Number	X coordinate	Y coordinate	Region
Left eye	1	lle + wle	tle + hle*4/5	Left eye
Right eye	2	lre	tre + hre/2	Right eye
Left eyebrow	17	llb + wlb/2	tlb + hlb/3	Left eyebrow
Right eyebrow	18	lrb + wrb/2	trb + hrb/2	Right eyebrow
Mouth	23	lmo	tmo + hmo/2	Mouth

[Evaluation of the FCP(Facial Characteristic Point)s]

30 FCP's;
lle, lre, llb, lrb, lmo:- left of left eye, right eye, left eyebrow, right eyebrow, mouth.
wle, wre, wrb, wlb:- width of left eye, right eye, left eyebrow, right eyebrow.
tle, tre, trb, tlb, tmo :- top of left eye, right eye, left eyebrow, right eyebrow, mouth.
hle, hre, hlb, hrb, hmo:- height of left eye, right eye, left eyebrow, right eyebrow, mouth.

Computation of Facial Animation Parameter:

Openness of eyes: ((fc7_y - fc5_y) + (fc8_y - fc6_y))/2
Width of eyes: ((fc1_x - fc3_x) + (fc4_x - fc2_x))/2
Height of eyebrows: ((fc19_y - fc1_y) + (fc20_y - fc2_y))/2
Opening of mouth: (fc26_y - fc25_y)
Width of mouth: (fc24_y - fc23_y)

where, fc1_x, fc2_x, fc3_x, fc4_x, fc7_y, fc5_y, fc8_y, fc6_y,

are the x, y direction position of the FCP"s distinguished around

the eye layout. Thus the FCP"s fc1_y, fc2_y, fc19_y,

fc20_y are the x, y direction position recognized around the

eyebrow layout. FCP"s fc23_y, fc24_y, fc25_y and fc26_y

are the y directions of mouth layout. Inferring these facial

parameters from FCP‟s, these highlights can be utilized to distinguish the class_label of face info

Rule Extraction from Decision Tree:

R1: IF oe> 20.5 THEN: Class_Label = „Surprise‟

R2: IF oe<=20.5 AND he<=20.67 THEN Class_label = „Angree‟

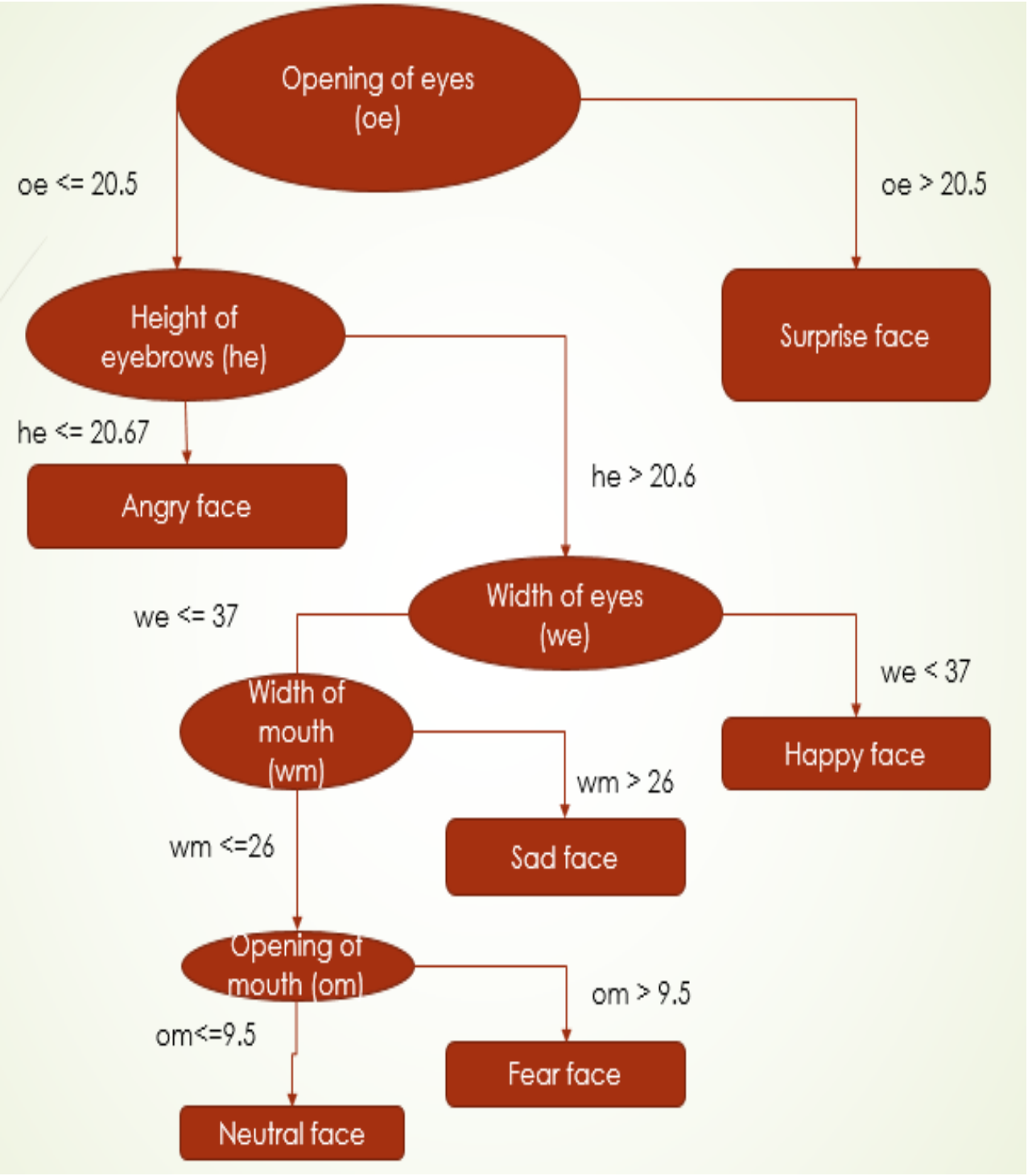
R3: IF oe<=20.5 AND he>20.67 AND we>37 THEN: Class_Label = „Happy‟

R4: IF oe<=20.5 AND he>20.67 AND we<=37 AND wm>26 THEN Class_Label = „ SAD‟.

R5: IF oe<=20.5 AND he>20.67 AND we<=37 AND wm<=26 AND om<9.5 THEN Class_Label = „Neutral‟

R6: IF oe<=20.5 AND he>20.67 AND we<=37 AND wm<26 and om >9.5 THEN Class_Label =‟Fear‟

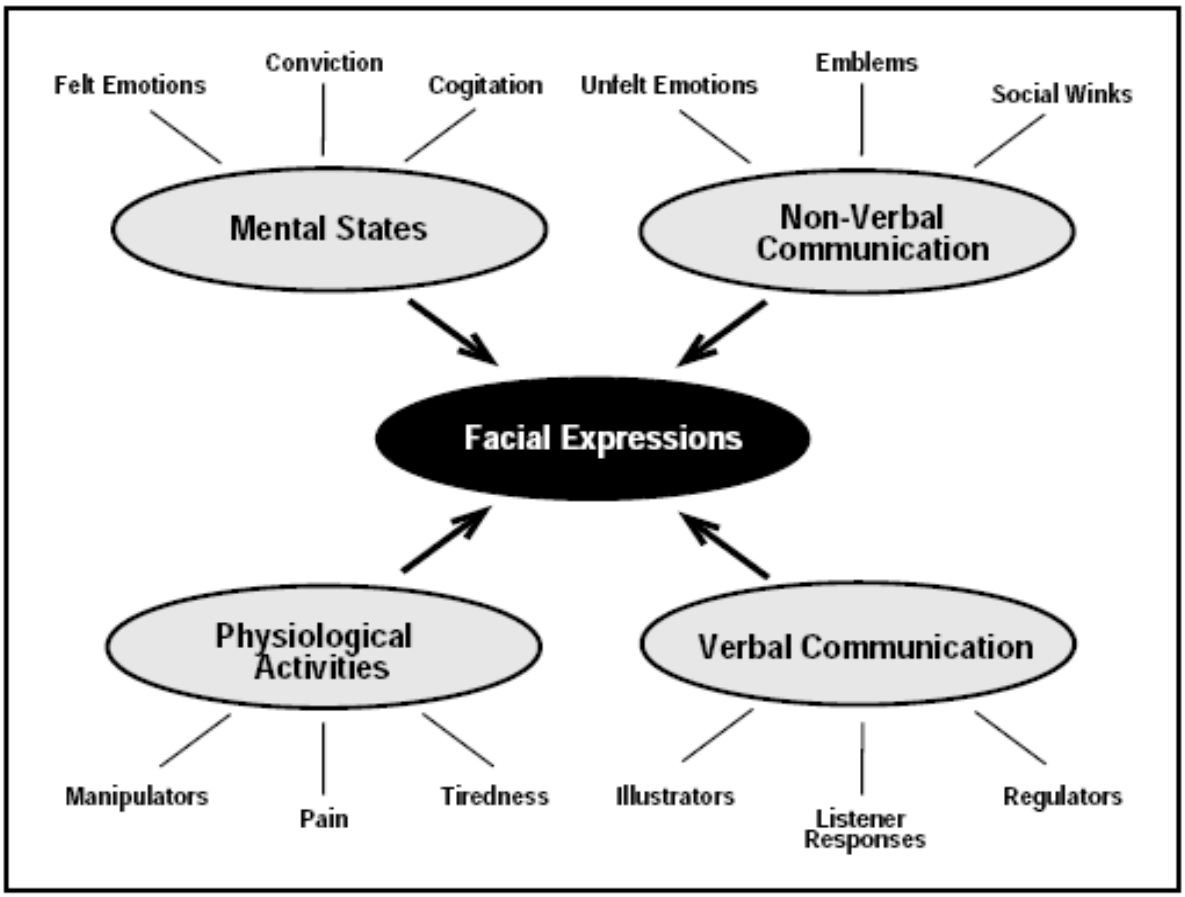
R7 : wm<=26 AND om>9.5 THEN Image is FEAR image.



[Decision Tree for classifying images]

Opening of eyes oe	Width of eyes we	Height of Eyebrows he	Opening of mouth om	Width of mouth wm	Class_Label
13.5	38.5	19.633	9.1677	27	Neutral
14.5	36	21.8	9.1677	26	Neutral
13.5	30	22.8167	8.333	23	Neutral
13.5	31.5	24.1333	8.333	24	Neutral
17	36.5	24.5	11.677	29	Neutral
15	44.5	26.3167	6.6667	31	Happy
17.5	39	30.033	9.1667	26	Happy
11.5	41.5	23.5167	8.33	25	Happy
21.5	44.5	26.3667	5.833	28	Happy
18	37.5	23.25	9.16667	22	Happy
25.5	32.5	34.9333	9.16667	26	Surprise
29	37.5	40.6167	11.667	29	Surprise
23.5	33	34.333	9.1667	28	Surprise
29.5	32.5	35.9833	12.5	24	Surprise
22.5	32	23.833	11.667	25	Surprise
15	34	21.8667	10	28	Sad
14	35.5	23.5333	6.667	28	Sad
13.5	37.5	19.9667	5.8333	29	Sad
13	30.5	21.3667	7.5	24	Sad
13	35.5	20.8667	5.8333	28	Sad
13.5	32	19.533	8.333	23	Angree
14	35	21.0667	8.333	30	Angree
13	34.5	16.7667	8.333	24	Angree
13.5	33	18.4833	7.5	26	Angree
13	35	17.4167	10.833	23	Angree

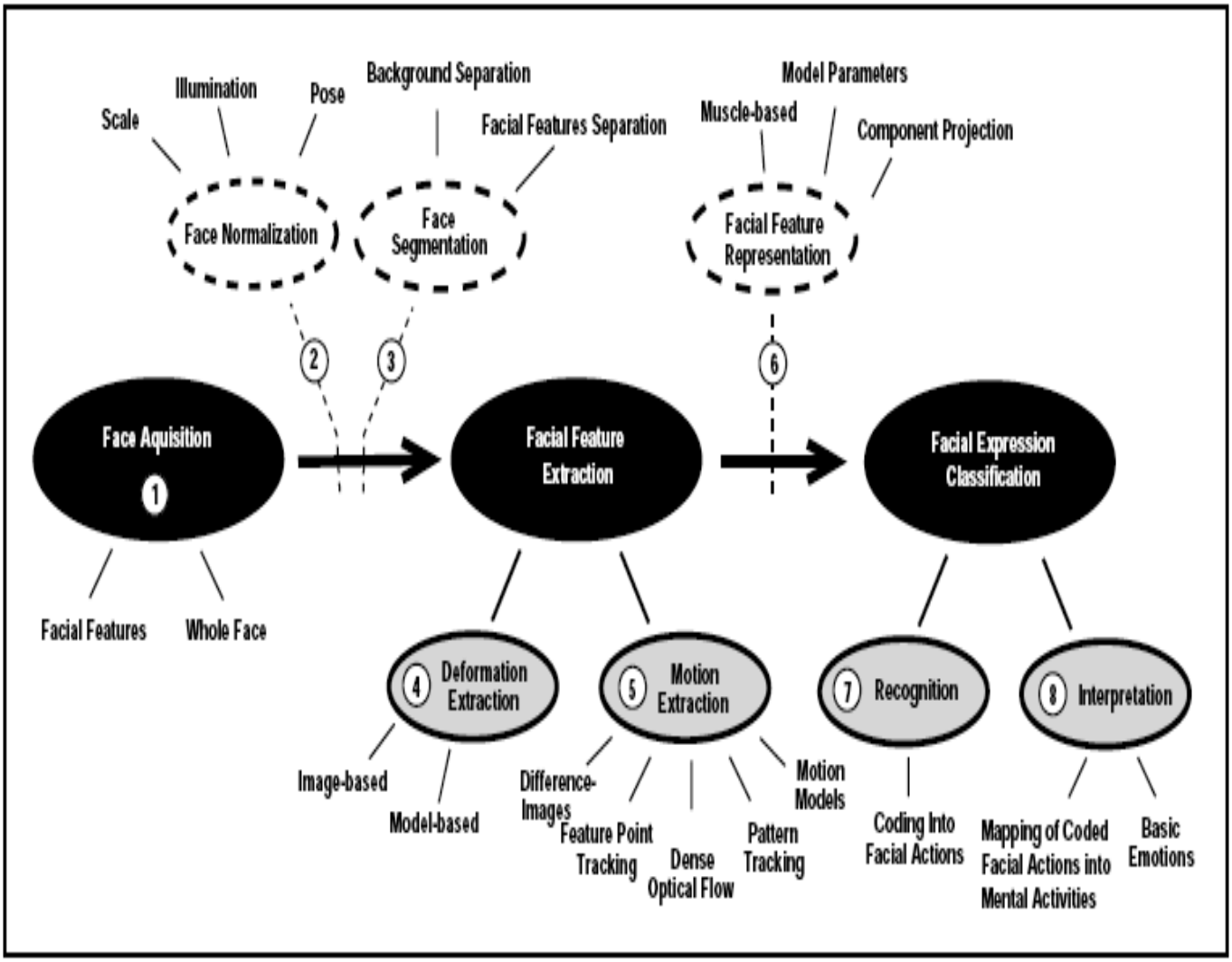
[Database table for 30 facial images]



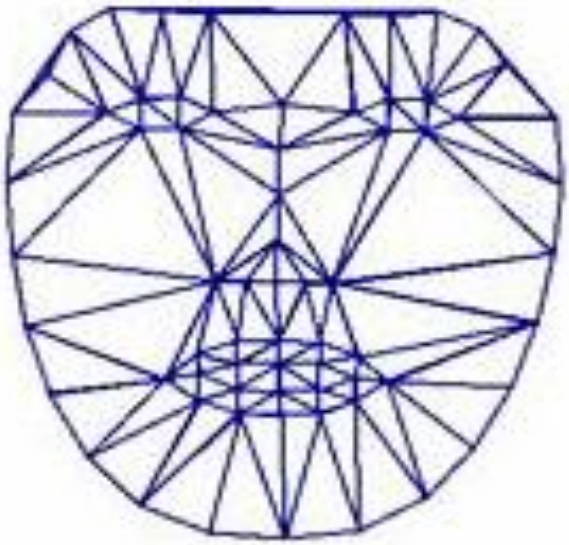
- **Ideal:**

  - Automatic facial image acquisition.
  - Subjects of any age, ethnicity and appearance.
  - Robust to variation in lightning.
  - Robust to partially occluded faces.
  - No special markers/make-up required.
  - Deals with rigid head motions.
  - Automatic face detection.
  - Automatic facial expression feature extraction.
  - Deals with inaccurate facial expression data.

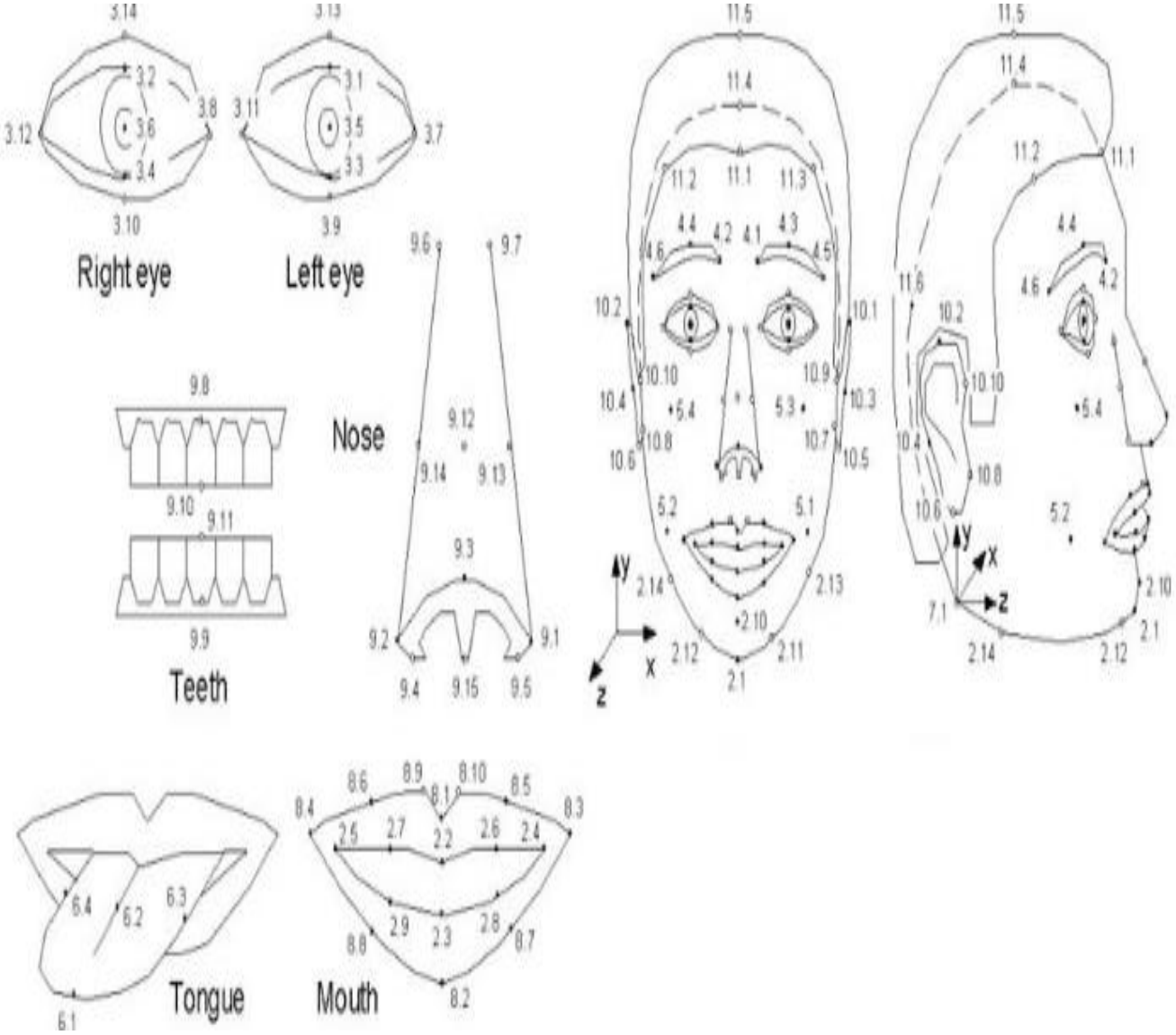
- Automatic facial expression classification.
- Discriminates all possible expressions.
- Deals with unilateral facial changes.
- Obeys anatomical rules.



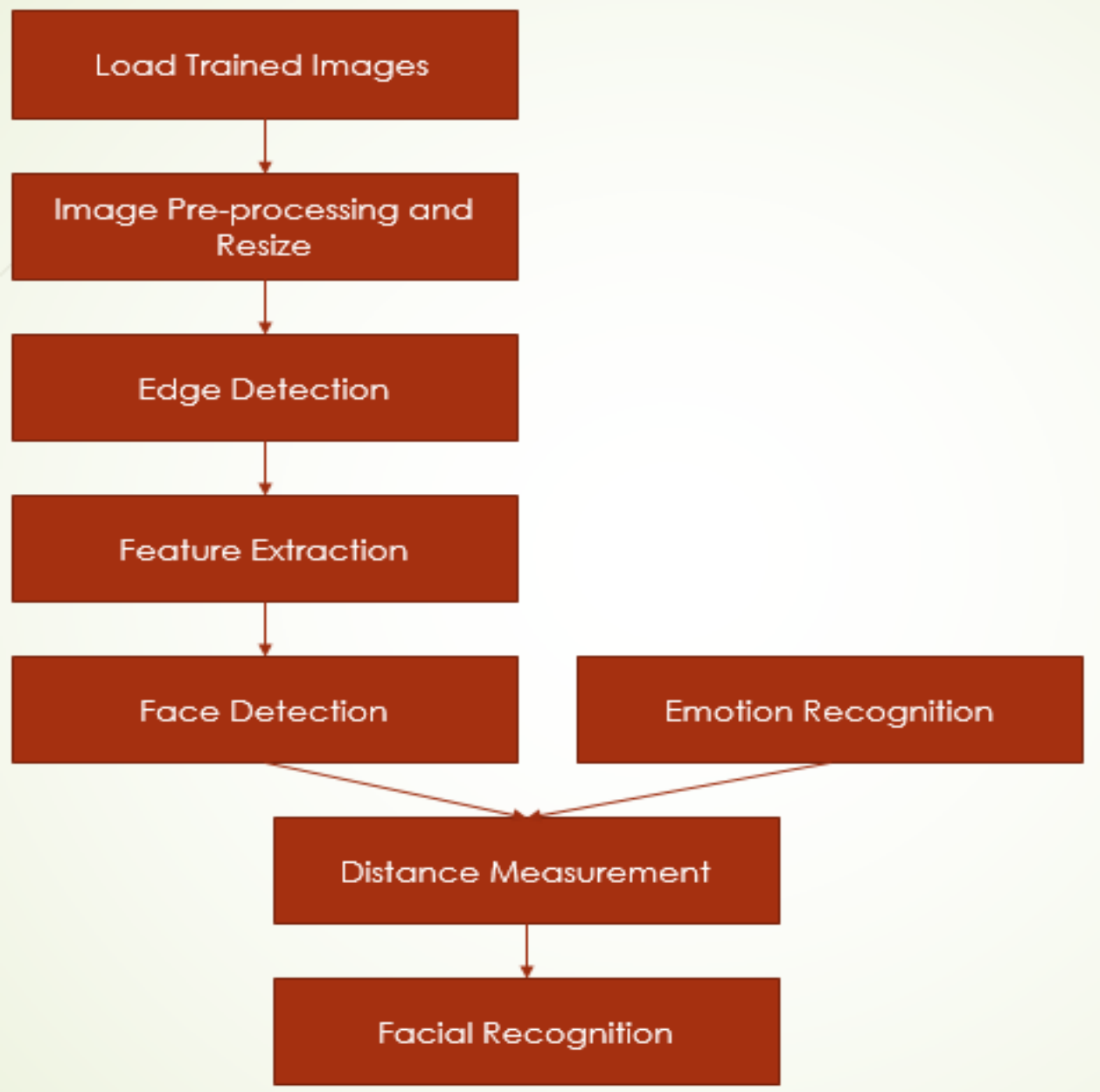
[Automatic Facial Expression Analysis]

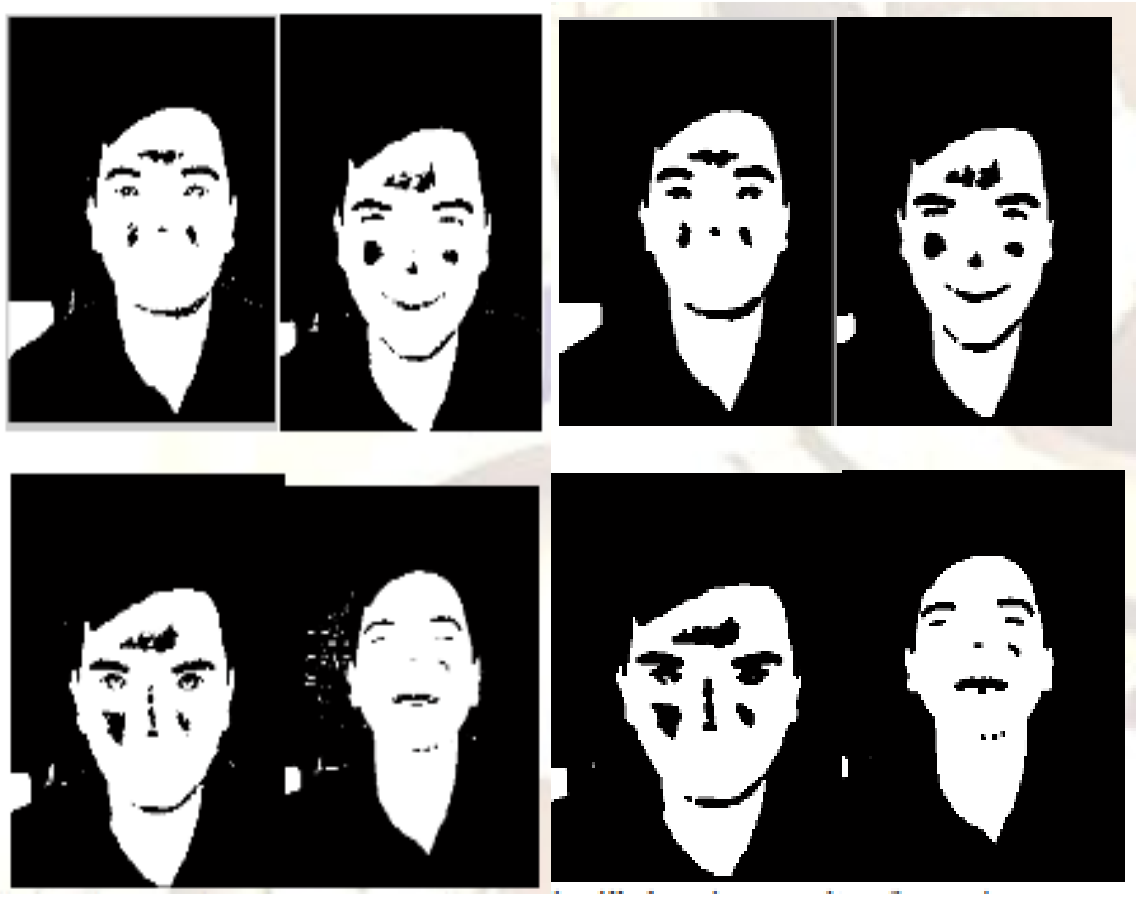


	Holistic	Local
Still image	-PCA -Edges -Colour -Gabor wavelet	-Active Contours -Blobs -Colour -Edges -Gabor wavelet -Local PCA -Template
Video based	-PCA -2D Discrete Cosine Transform (DCT) -Optical Flow	-Local PCA -Local Optical Flow -Active Contours

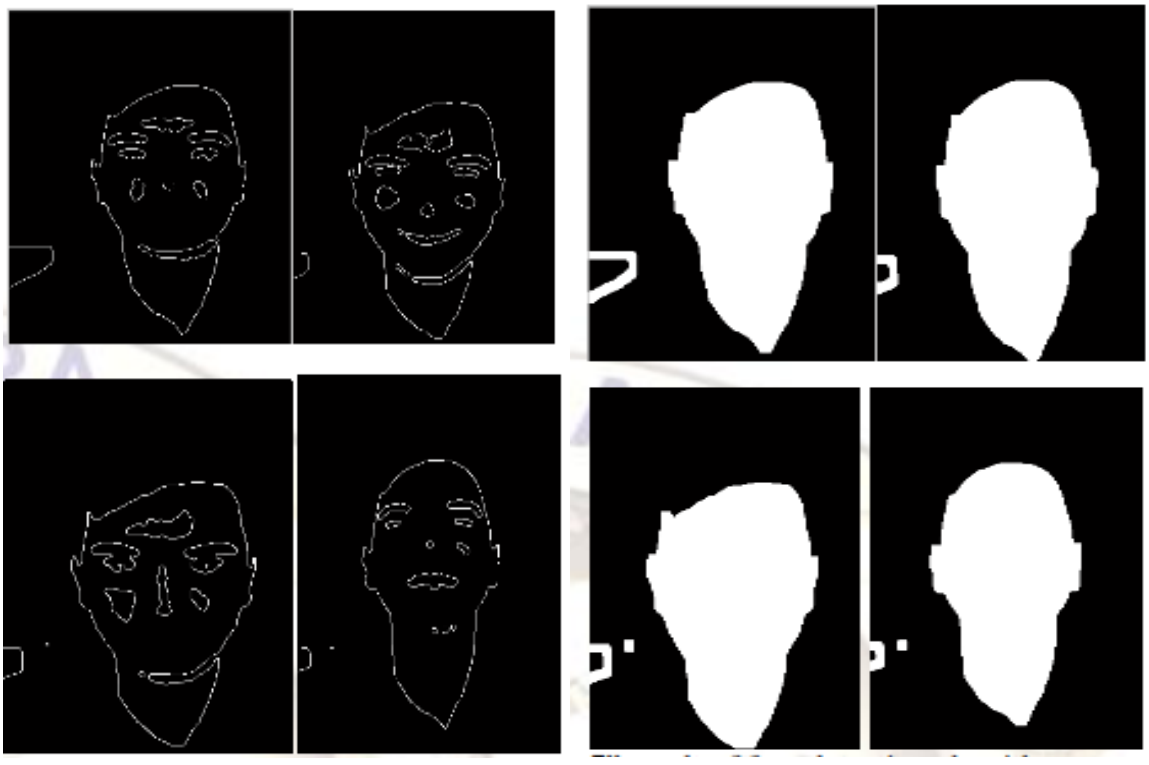


[Facial Characteristic Points]


Load Trained Images
Image Pre-processing and Resize
Edge Detection
Feature Extraction
Face Detection
Emotion Recognition
Distance Measurement
Facial Recognition



[Pre-processing steps] [After noise removal]

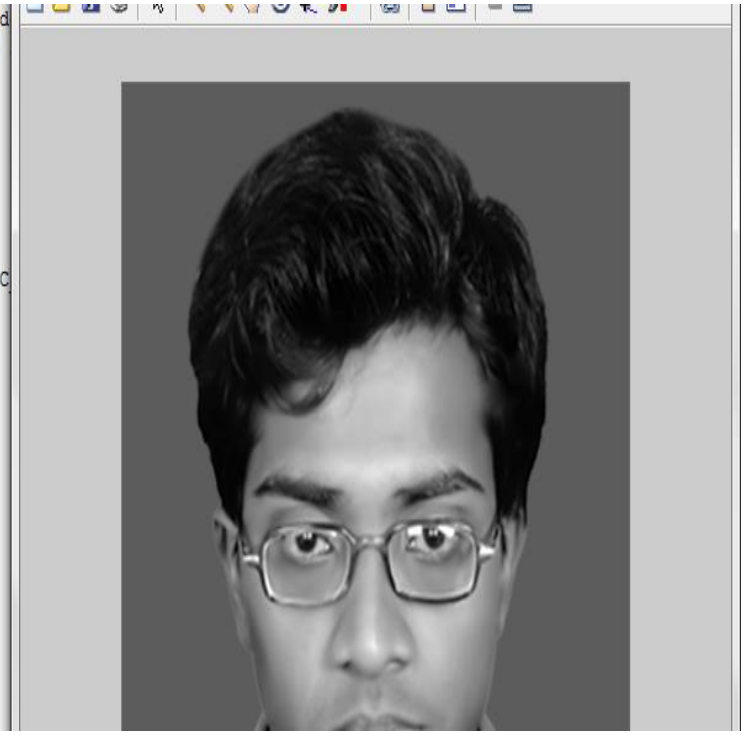


[Edge Detection] [Face Detction Algorithm]

```
An image has just been selected. Now you can ad
or perform facial epression recognition (click

Training in progress, please wait.
System has been successfully trained.
Time required: 0.023278

Input image location:
C:\Users\BIKASH\Documents\PSU's_new\My_Data\DSC
Recognized facial expression: Sadness
```



CHAPTER 3

Literature Review:

- **Face Recognition utilizing Eigen-confronts, Fisher-appearances and Neural Networks:**

Sahoolizadeh et al. proposed another face acknowledgment strategy which is taking into account the PCA (vital part examination), LDA (straight discriminant investigation) and NN (neural systems) and in this technique for face acknowledgment there are four stages:

1) In first step the pre-processing is done in this all the picture of the database are first sliced physically to 40 × 40 pictures so the foundation data can evacuate and have just face subtle elements.

2) After the preprocessing next step is diminishment of the measurement, They utilized essential part examination for the lessening of dimension.

3) For the highlight extraction they utilized the direct discriminant examination.

4) After highlight extraction the last step is to do the classification by utilizing the neural system also, when couple of number of test pictures are accessible the mix of PCA what's more, LDA enhances the ability of LDA, and the utilization of neural system classifier diminish the quantity of misclassification and in the wake of utilizing the PCA for highlight extraction and measurement diminishment we have to choose the fisher faces taking into account the nonzero eigenvector and after that they for the classification of the info information they have utilized a thee layers perceptron neural system in which there is 40 neurons in the info layer, and 20 layers in the covered up layer are utilized and as a part of the last layer (yield layer) 10 neurons have utilized. Furthermore, as per the coveted qualities for the overhauls of weights a basic back engendering calculations are utilized and by utilizing LDA highlights the three layers MLP neural system is prepared and Training LDA highlights enter the neural system and as indicated by their class, a back spread lapse,

spread on the system and right the weights toward the right values and this new proposed technique for efficient face classification is getting a high acknowledgment rate which is equivalents to more than 99 rate. the recreation utilized the YALE face datasets and this new strategy for the face acknowledgment can utilized for the numerous application.

- **Face Recognition utilizing Principal Component Analysis:**

Kim et al. proposed a face acknowledgment technique in which they have utilized the important segment investigation for the measurement diminishment and for the highlight extraction. In this the two dimensional facial pictures express into the expansive one dimensional vector structure and principle thought of this is to express this one dimensional vector into a reduced vital segment of highlight space. This is otherwise called eigenspace projection. In this paper they have reshaped the 2-D picture of N×N into a N 2 ×1. What's more, they have taken the ORL database for the reenactment and as opposed to putting away all pictures from the database they have computed the mean of this databases picture and subtract this with all the 1-D N 2 × 1 pictures. After subtraction they got the pictures with novel highlight, then they have ascertained the eigenvalues and the eigenvectors of the covariance lattice. On the premise of the eigenvalues some eigenvectors are chosen as a main part. In the wake of selecting the eigenfaces they have figured the Euclidean separation. They were considered in the face identification. They have classified the face into the non-face or obscure appearances and that the given face is there in the database or not. As all pictures is very related with itself. Furthermore, the first eigenface can be utilized as a filter. The picture with low relationship can be rejected or we can say it can be classified into a non-confront classification.

They have chosen a limit on the premise of that they have given the accompanying conclusion:

1. Close face space furthermore, close put away face ⇒ known appearances.

2. Close face space, however not close to a known face ⇒ obscure appearances.

3. Separation from face space and close to a face class ⇒ non-confronts.

4. Separation from face space and not close to a known

- **Eigenfaces versus Fisherfaces: Recognition Using Class Specific Linear**

Projection:

Belhumeur et al. In this they have added to another calculation for the faceacknowledgment which is not made a fuss over the huge variety in the lighting heading furthermore no issue if there is variety in outward appearance. Implies they have proposed a calculation which is Insensitive in different changes in the facial pictures. They have utilized an example classification approach as a part of this what's more, they have taken the every pixel of the pictures as a direction in a high dimensional space. The pictures of any face under fluctuating enlightenment, yet no adjustment in facial posture, lie in 3D direct subspace of the high dimensional picture space. So they took it as leverage. In this they directly anticipated the picture into a subspace in such a way, to the point that rebates the areas of the face which has the substantial deviation. This technique for the projection is principally in light of the Fishers direct discriminant and this technique delivered all around divided class in a low-dimensional subspace. They have tried this strategy with the Harvard and Yale face databases and they have got from the test that the Fisher facestrategy has a lower mistake rate as looked at to the Eigen face system.

- **Face Recognition Using Kernel Eigenfaces:**

Yang et al. In this they have enhanced the some downside of the main part examination, for example, the PCA is exceptionally helpful for the measurement diminishment, however it is just for the second request measurements of any picture and it doesn't work for the higher request measurements (HOS) conditions. Higher request measurements (HOS) conditions implies the connections among the three then again more pixels. They have explored a speculation of PCA. The higher request insights are processed by the bit key segment examination without blast of time and memory many-sided quality. By and large PCA finds the connection of the

second request of examples, however in this they have done by the bit central segment investigation which takes higher request connection. They got the outcome with this technique which is enhanced from the PCA. They have utilized two picture databases for the test of this new strategy the AT and T database and Yale database. The AT and T database is contained of the 400 frontal face pictures. In 400 pictures 40 subjects of a different posture and variety in outward appearance is there. Furthermore, it additionally tried for the Yale database which contained 165 pictures of 11 subjects. In the PCA every example can be remade by utilizing all the Eigen vectors and the foremost segments.

In any case, in this analysis they arrived at that point is no immediate partners in piece central part investigation like in the PCA. As the picture set of the Eigen face methodologies is second request measurements and not utilized higher request insights, conditions like the relationship among three or more pixels. They have tried on the two datasets they examined that bit PCA gives an effective representation for face acknowledgment. Also, they have thought about their results with different methods it gives better results.

- **Facial Expression Recognition:**

  - **Principal Component Analysis:**

Vital Component Analysis (PCA), otherwise called the eigen face methodology is one of the mainstream technique for outward appearance recognition. The real objective of PCA is to decrease the dimensionality for compelling face indexing and recovery. Likewise, PCA utilizes direct projection, which expand the anticipated example scrambling. In this, the personality of the individual is the main differing factor. PCA faces difficulty if different variables like perspective, lighting are changed.

  - **Fisher's Linear Discriminant:**

Under serious variety in outward appearance and brightening Fisher's Linear Discriminant (FLD) is more suitable. FLD decreases the dispersing of anticipated example since it is a class particular method. Slip rate is reduced when contrasted with PC.

- **Independent Component Analysis:**

Both PCA and LDA create spatially worldwide highlight vectors. Yet, for viable outward appearance acknowledgment spatially limited highlight vectors is required. Along these lines Independent Component Analysis (ICA) produces measurably autonomous premise vector. The normal acknowledgment rate is made strides. Yet, ICA is computationally costly than PCA.

- **2-D Principal Component Analysis:**

In PCA, highlight extraction is done in light of 1D vectors. Thusly the picture framework need to be changed into vector. 2dimensional Principal Component Analysis (2DPCA) uses 2D grid rather than 1D vector. The acknowledgment rate of 2DPCA is higher than PCA. Anyhow, the capacity necessity for 2DPCA is higher than PCA since 2DPCA needs more coefficients for picture representation.

- **Global Eigen Approach using colour images:**

Traditional outward appearance acknowledgment systems like PCA, LDA and so on utilizations just the luminance data in face pictures. Worldwide Eigen Approach utilizes the shading data as a part of face images. RGB shading space does not give any change in recognition rate. In HSV shading space, H part is uprooted following it decreases acknowledgment rate. YUV colour space gives high acknowledgment rate.

- **Sub-pattern Extended 2-D PCA:**

The acknowledgment rate of PCA is low and has little specimen size issue. For dim outward appearance acknowledgment, 2DPCA is stretched out to Extended 2DPCA. At the same time, E2DPCA is not relevant for shading pictures.

In this way Sub example extended 2-Dimensional PCA (SpE2DPCA) is presented for shading face recognition.

The acknowledgment rate is higher than PCA, 2DPCA, E2DPCA and issue of little specimen measure in PCA.

- **Multi linear Image Analysis:**

Outward appearance acknowledgment needs changed components like stance, lighting, declarations to be considered. Yet, the

ordinary PCA addresses just varieties in single variable. Multi linear picture examination use multi linear algebra. In this, the idea of „Tensor faces" is utilized, which differentiates diverse variables fundamental the arrangement of a picture. Acknowledgment rate is more noteworthy when contrasted with PCA approach. Shading data is not consolidated in multi linear picture investigation.

- **Colour sub-space Linear Discrimination Analysis:**

The 1DLDA AND 2DLDA are stretched out in shading space to enhance the face acknowledgment exactness. A 3D shading tensor is utilized to create shading LDA subspace. Flat unfolding builds the acknowledgment rate for 2D LDA while vertical unfolding enhances acknowledgment rate for 2DPCA.The execution assessment of different shading spaces is not done.

- **2-D Gabor Filter Bank:**

The Gabor sifting is considered as a standout amongst the most vital highlight extraction procedure in Facial Interpretation recognition. Gabor channel bank performs better as far as acknowledgment rate than alternate systems like PCA, LDA etc. The real restriction of gabor channel is its transmission capacity limit ie. most extreme data transmission is restricted to one octave. Gabor channels misfortune high and low recurrence data since it is band go in nature.

CHAPTER 4

Conclusion:

The principle disadvantage of utilizing this strategy is it is not ready to give a more exact result when there is change in the enlightenment. So we can enhance it by utilizing the geometric (highlight based) approach in which we have to choose just some particular highlight like nose, eyes, and mouth and measure the geometric relationship between these facial focuses. So by this we can enhance the exactness rate later on.

Bibiliography:

1. *Y. S. Gao, M. K. H. Leung, S. C. Hui, and M. W. Tananda, "Facial expression recognition from line-based caricature," IEEE Trans.*
2. *System, Man, & Cybernetics (Part A), vol. 33, no. 3, pp. 407-412, May 2003.*
3. *Y. Xiao, N. P. Chandrasiri, Y. Tadokoro, and M. Oda, "Recognition offacial expressions using 2-D DCT and neural network," Electronics*
4. *and Communications in Japan, Part 3, vo. 82, no. 7, pp.1-11, July 1999.*
5. *J.-Y. Chang and J.-L. Chen, "A facial expression recognition system using neural networks", in Proc. IJCNN '99, pp. 3511-3516, vol. 5*
6. *1999.*
7. *F. Kawakami, H. Yamada, S. Morishima, and H. Harashima, "Construction and psychological evaluation of 3-D emotion space,"Biomedical Fuzzy and Human Sciences, vol. 1, no. 1, pp. 33-42, 1995.*
8. *M. Rosenblum, Y. Yacoob, and L. S. Davis, "Human expressiorecognition from motion using a radial basis function network architecture," IEEE Trans. on Neural Networks, vol. 7, no. 5, pp1121-1138, Sept. 1996.*
9. *M. Pantic and L. J. M. Rothkrantz, "Automatic analysis of facial expressions: The state of the art," IEEE Trans. Pattern Analysis &Machine Intelligence, vol. 22, no. 12, pp. 1424-1445, Dec. 2000.*
10. *Z. Zeng, M. Pantic, G. I. Roisman, and T. S. Huang. A survey of affect recognition methods: audio, visual, and spontaneous expressions.*
11. *IEEE Trans. Pattern Analysis and Machine Intelligence, 31(1):39–58, 2009.*
12. *G. Zhao and M. Pietikainen. Dynamic texture recognition using local binary pattern with an application to facial expressions. IEEE Trans. Pattern Analysis and Machine Intelligence, 2(6), 2007.*
13. *Y. Tian, T. Kanade, and J. Cohn. Recognizing action units for facial expression analysis. IEEE Trans. Pattern Analysis and Machine*
14. *Intelligence, 23(2), 2001.*
15. *Y. Tong, J. Chen, and Q. Ji. A unified probabilistic framework for spontaneous facial action modeling and understanding.*

Transactions on Pattern Analysis and Machine Intelligence, pages 1-16, Dec 2000.

16. **Hidden Markov Models for face recognition – Ara V. Nefian and Monson H. Hayes III (Center for Signal Image Preprocessing , School of Electrical & Computer Engineering, Georgia Institute of Technology,Atlanta)**
17. **Facial Recognition using Singular Value Decomposition – Nicolas M. Bertagnolli, Russel Canning, Jason M. Davis, and Denver J. Hoggatt (Dept. of Mathematics, Dept. of Computer Science, Dept. of Electrical & Computer Engg., University of Utah)**
18. **Face verification based on Singular Value Decomposition & Radial Basis Function Neural Network – Yunhung Wang, Tieniu Tan & Yong Zhu (National Laboratory of Pattern Recognition, Institute of Automation, Chinese Academy of Sciences, Beijing, China)**
19. **Face Recognition Feature Comparison Based SVD and FFT – Lina Zhao, Wanbao Hu, Lihong Cui (School of Science, Beijing Univesity of Chemical Science, Beijing, China)**
20. **An efficient Algorithm for Human Face Detection and Facial feature Extraction under different Conditions – Kwok Wai Wong, Kin-Man Lam*, Wan-Chi Siu (Center for Multi-Media Signal Processing, Dept. of Electronic and Information Engg., The Hong-Kong Polytechnic University, Hung Hom, Hong Kong)**